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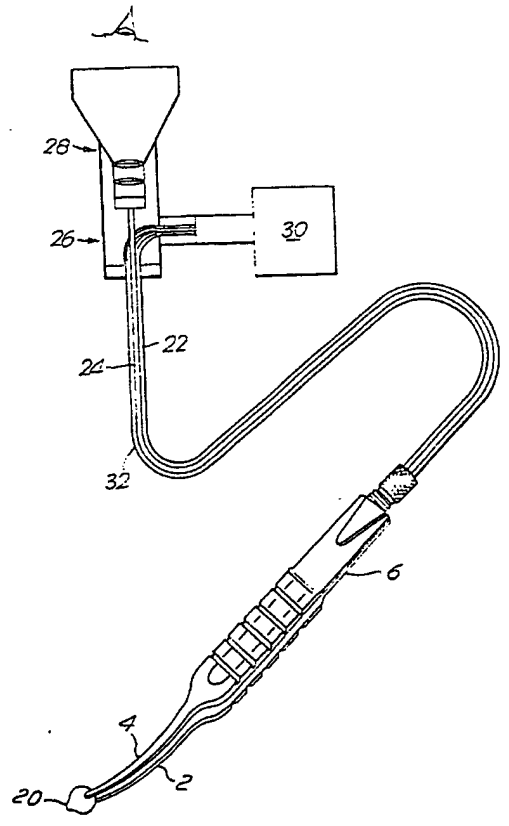
(57) Abstract

The present invention relates to surgical forceps. During surgery forceps are frequently used to grip and manipulate tissue. For large scale surgery the operating table is sufficiently well illuminated to enable the surgeon to identify and grip tissue as required. With the advent of microsurgery substantially more accurate positioning of the forceps is required and it is often the case that the forceps itself will intervene between the eye of the surgeon and the precise area of tissue to be gripped thus creating uncertainty as to whether the correct piece of tissue is being gripped. A pair of microsurgical forceps has a shank (6), and a pair of resilient arms (2, 4) extending from the shank (6) and each terminating in a curved tip portion (2a, 4a). At least two fibre optic bundles (14, 16) extend from the shank (6) to a position adjacent at least to one of said tip portions (2a, 4a). A light source is connected to one bundle (14) to illuminate the area between the tip portions, and an endoscope is coupled to the other bundle (16) to enable the area between the tips to be viewed whereby to enable any gripping action performed by the forceps to be visually monitored.



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FORCEPS

The present invention relates to forceps and in particular to surgical or microsurgical forceps.

During surgery forceps are frequently used to grip and manipulate tissue. For large scale surgery the operating table is sufficiently well illuminated to enable the surgeon to identify and grip tissue as required. With the advent of microsurgery substantially more accurate positioning of the forceps is required and it is often the case that the forceps itself will intervene between the eye of the surgeon and the precise area of tissue to be gripped thus creating uncertainty as to whether the correct piece of tissue is being gripped.

It is an object of the invention to provide improved forceps.

According to the present invention there is provided forceps having a shank, a pair of resilient arms extending from the shank and each terminating in a tip portion and at least two light conducting paths extending from the shank to a position adjacent at least to one of said tip portions, a light source connected to one light conducting path to illuminate the area between the tip portions, and an endoscope coupled to the other light path to enable the area between the tips to be viewed whereby to enable any gripping action performed by the forceps to be visually monitored.

Preferably each light conducting path comprises a bundle of optical fibres.

Advantageously one said light path extends along the inner face of one of said resilient arms and the other said light path extends along the inner face of the other of said resilient arms.

Instead both said light paths extend along the inner face of the same arm.

The inner face of the or each arm may have a channel for accommodating the light conducting path. Each light path advantageously terminates in a lens which is focused on the area between the tip portions.

In a modification at least one of said optical fibre bundles comprises a section which has been reduced in diameter by drawing through a die.

In a further modification at least one of said light paths may extend along the outer surface of an arm instead of an inner surface thereof and pass to the inner surface through an opening in the arm at a location adjacent a said tip.

Said two bundles of optical fibres may be encased in a common sleeve with the bundle supplying the endoscope being surrounded by the bundle which is connected to the light source.

Instead said bundles may lie in side by side parallel relationship.

Forceps embodying the invention will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a pair of forceps incorporating an endoscope and light source.

Figure 2 is a section through the endoscope and light source of Figure 1.

Figure 3 is a plan view of the foreceps;

Figure 4 is a side elevation of the forceps of Figure 3;

Figure 5 is an underplan view of the upper arm of the forceps of Figure 4;

Figure 6 is a fragmentary side elevation, to an enlarged scale, of the tip end portion of the

forceps of Figure 1 holding a piece of tissue;

Figure 7 is a section of the lower arm of the forceps taken on line X-X in Figure 3.

The stainless steel forceps shown in the drawings has two arms 2,4 linked together by a shank portion 6 at one end, and having arcuate end portions 2a and 4a at the opposite end. Each end portion 2a and 4a terminates in a tip portion 2b and 4b.

Each arm 2,4 is provided with a respective series of ribs 8 and 10 providing finger gripping areas of the forceps. A pair of stops 12 are provided in the inner face of one arm 2 to limit the extent to which the arms can be moved towards one another.

A groove (14 and 16) is provided along the inner face of each arm (2 and 4). At the shank end of the forceps, the grooves 14 and 16 communicate with a common passage 18 extending through the shank 6. At the top end of the forceps each groove 14 and 16 terminates in a stepped portion formed on the inner face of the respective arms 2 and 4 (see Figure 6). The ends of the grooves may lie some 3 mm from the furthest extremities of the arms.

Each groove houses a respective bundle 22 and 24 of fibre optic cables. The bundles are preferably adhesively secured in the grooves but may instead be a press-fit. The ends of the two fibre optic bundles emerging from the channel 18 in the shank are coupled through a fibre optic coupler 26 to an endoscope 28 and a light source 30.

The two bundles 22 and 24 are concentrically arranged in a common sheath or sleeve 32 with the coherent bundle connected to the endoscope 28 being encircled by the bundle connected to the light source 30. The terminating ends of the

fibre optic bundles at the tip end portions of the forceps are provided with lenses or are so profiled as to act as lenses, so that light from the light source 30 becomes focused into the area between the tips and so that the endoscope 28 can focus on the area between the tips. In a modification the lens may be omitted from the end of the bundle 24 so that light is generally scattered in the area between the tips. In this way any tissue 20 gripped by the forceps can be brightly illuminated and visually monitored right up to the point at which the tissue is clamped between the tips. If the fibre optic bundles are extended to the tip they will allow the tissue to be visually monitored even while being gripped.

In a modification a third bundle of optical fibres can be provided or, instead one of the existing two bundles used, to subject the gripped tissue to laser irradiation for medical treatment purposes e.g. to effect cauterisation.

In yet another modification the fibre optic bundles instead of extending along respective inner faces of the forceps can both extend along the same inner face.

Another way in which the fibre optic bundles can be brought to the tip portions is to run them along the outer faces of the forceps and then bring them to the inner face by passing them through an, or a respective, opening adjacent the tips.

The optical coupler 26 and endoscope 28 are more clearly shown in Figure 2. As shown the concentric fibre optic bundles enter the coupler 26 through a cylindrical clamping member 40. As the bundles emerge from the clamp 40 they are separated with the bundle 24 extending rectilinearly into the

jaws of a further clamp 42.

The terminating ends of the fibres in the bundle 24 are coherent, that is, they have the same positional relationship as the terminating ends at the opposite end of the bundle. The picture viewed by one end of the bundle is thus precisely the same picture which is produced at the opposite end of the bundle.

This picture after magnification by four magnifying lenses 44 can be viewed by an operator through an eye piece 46.

The fibre optic bundle 22 separates from the bundle 24 after it emerges from the clamp 40 and extends at right angles to be gripped by yet another clamp. The bundle as it emerges from the clamp 48 becomes enlarged i.e. the diameter of each fibre is increased. The enlarged fibres terminate in common plane ready to receive light from the source 30. The arrangement thus provides a larger light collecting area to allow more light to be pumped through the bundle than could otherwise be achieved.

The enlargement of the fibre diameter is achieved by starting with an optical fibre bundle of large diameter fibres and drawing the whole bundle through a die or a series of dies to reduce the overall diameter of the bundle into the range of from 0.1 to 1.0 mm. Some heating of the bundle may be necessary.

The two bundles 22 and 24 when passing through the sheath and into the forceps may have an overall diameter in the range of from 0.5 to 1.5mm.

In a modification the terminating end portions of the fibre optic bundles are not secured to the arms but are stiff but flexible to enable them to be manipulated so that their optical axes can be

oriented as required. In this way full illumination and visibility can be given for any particular direction of approach chosen for the forceps.

CLAIMS

1. Forceps having a shank, a pair of resilient arms extending from the shank and each terminating in a tip portion and at least two light conducting paths extending from the shank to a position adjacent at least to one of said tip portions, a light source connected to one light conducting path to illuminate the area between the tip portions, and an endoscope coupled to the other light path to enable the area between the tips to be viewed whereby to enable any gripping action performed by the forceps to be visually monitored.

2. Forceps according to Claim 1 wherein each light conducting path comprises a bundle of optical fibres.

3. Forceps according to Claim 1 wherein one said light path extends along the inner face of one of said resilient arms and the other said light path extends along the inner face of the other of said resilient arms.

4. Forceps according to Claim 1 or to Claim 2 wherein both said light paths extend along the inner face of the same arm.

5. Forceps according to Claim 1 or to Claim 2 wherein the inner face of the or each arm has a channel for accommodating the light conducting path.

6. Forceps according to any preceding claim wherein each light path terminates in a lens which is focused on the area between the tip portions.

7. Forceps according to Claim 2 wherein at least one of said optical fibre bundles comprises a section which has been reduced in diameter by drawing through a die.

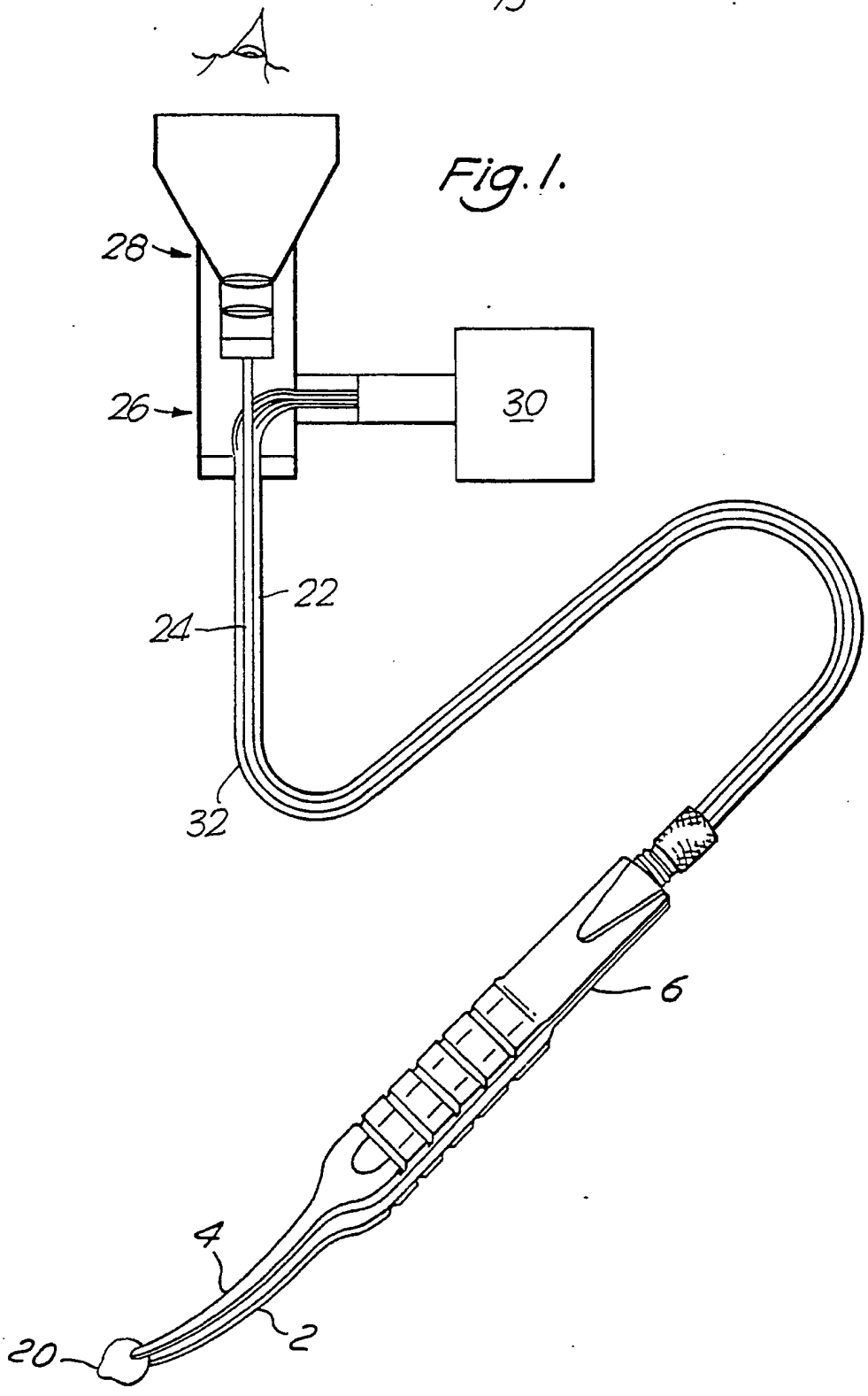
8. Forceps according to Claim 1 or to Claim 2 wherein at least one of said light paths extends

along the outer surface of an arm and passes to the inner surface through an opening in the arm at a location adjacent a said tip.

9. Forceps according to Claim 2 or any one of Claims 3 to 8 as dependent upon Claim 2 wherein said two bundles of optical fibres are encased in a common sleeve with the bundle supplying the endoscope being surrounded by the bundle which is connected to the light source.

10. Forceps according to Claim 2 or any one of Claims 3 to 8 as dependent upon Claim 2 wherein said bundles lie in side by side parallel relationship.

Fig. 1.



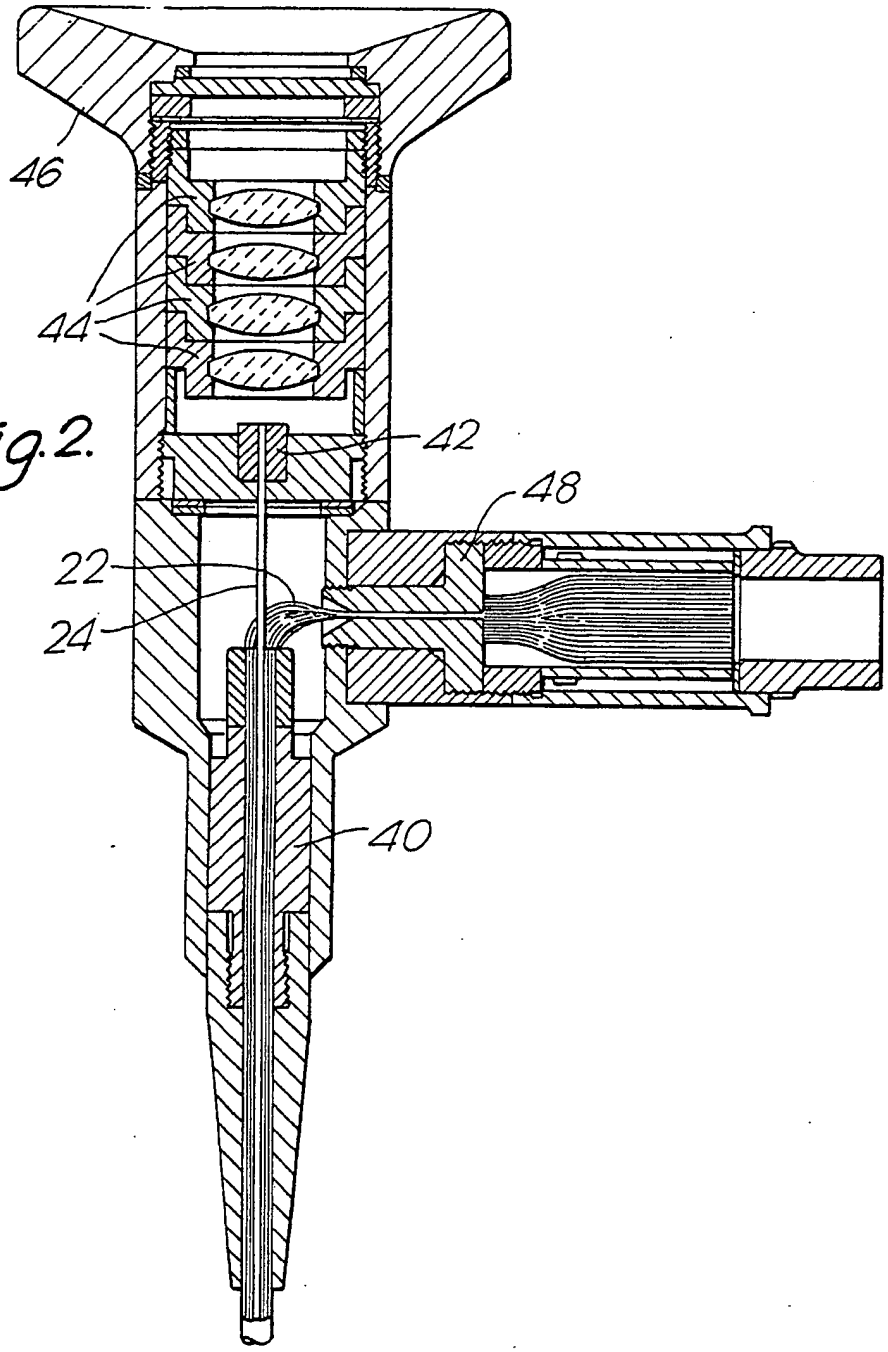


Fig.2.

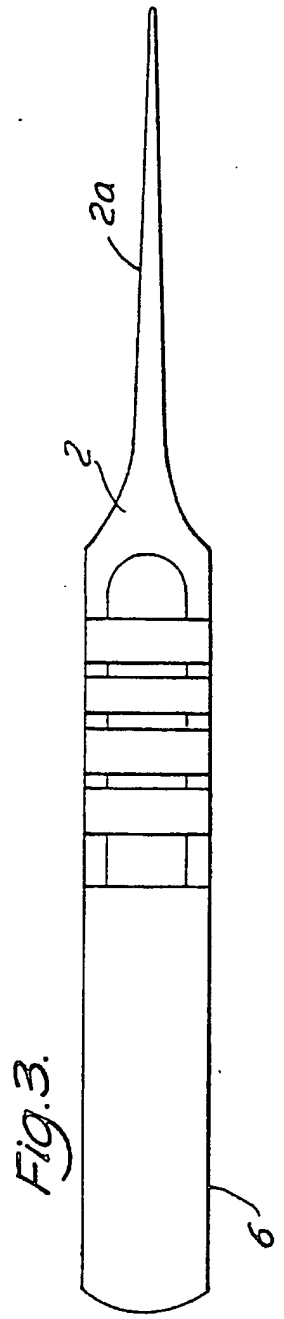


Fig.3.

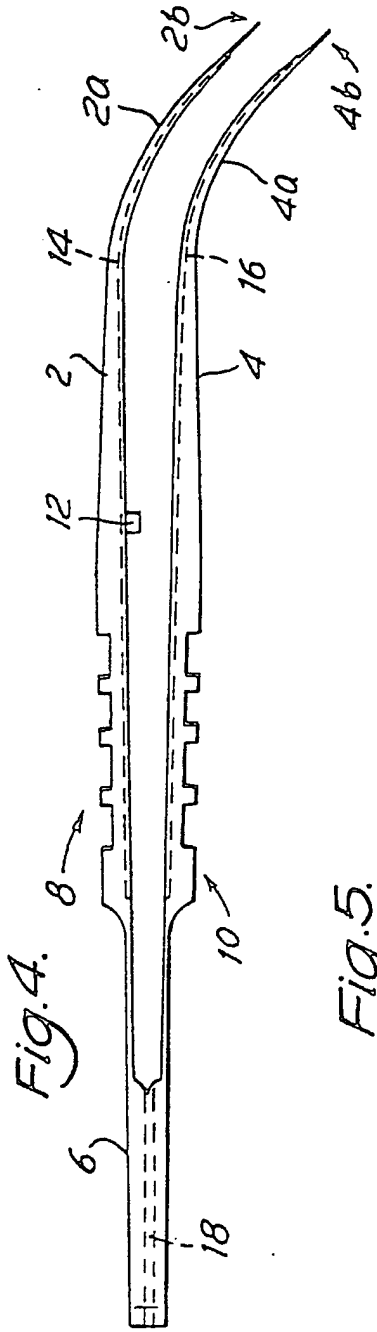


Fig.4.

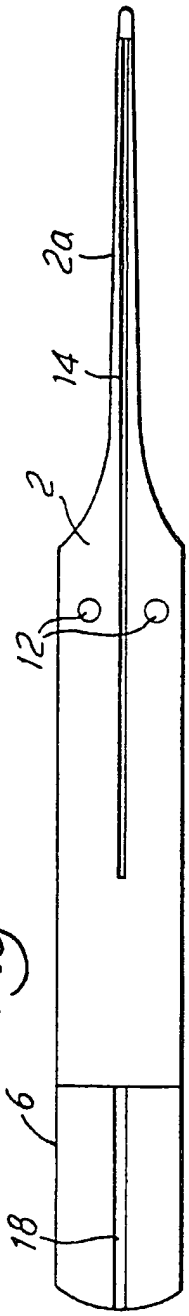


Fig.5.

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/00349

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: A 61 B 17/30, 19/00, 17/36, 1/06

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	A 61 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category [10]	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 3664330 (DEUTSCH) 23 May 1972, see the whole document	1,2,3,6
Y		4,5,7-10
Y	US, A, 4562832 (WILDER) 7 January 1986, see figures 4-6; abstract; column 8, lines 16-57	4
Y	EP, A, 0156472 (MICRA) 2 October 1985, see figures; page 2, line 12 - page 3, line 28	5,8
Y	US, A, 3327712 (KAUFMAN) 27 June 1967, see figures; column 3, lines 49-63	7,9,10
A	EP, A, 0070459 (TAKENAKA) 26 January 1983	
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
2nd July 1990	26.07.90
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	F.W. HECK

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3664330	23-05-72	None	
US-A- 4562832	07-01-86	US-A- 4605990	12-08-86
EP-A- 0156472	02-10-85	GB-A,B 2154930	18-09-85
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